GENERAL DISCUSSION

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The results obtained in the present investigation have been discussed in detail at appropriate places in different chapters. However, in this chapt, efforts have been made to correlate the results as well as to draw certain conclusions where ever possible.

In spite of the recent extensive studies by many investigators on physiology and biochemistry of pathogenic fungi, the point of emphasis regarding their general behaviour has not been attained so far. The main feature of these studies is its apparent diversity of responses exhibited by the organisms to the compounds encountered in nature. A comparative knowledge of the subject might be of some aid in understanding the relationship between the host and the parasite. Garber (1956) emphasized the need for an adequate nutritional environment in the host to permit the potential proliferation and metabolism of the infective parasite. Present *in vitro* studies gives information on the preference of nutrients by *F. udum*, *F. pallidoroseum*, *F.oxysporum* and *F.moniliforme* and factors governing their growth and sporulation.

Detailed physiological investigations were carried out on four species of *Fusarium* to observe the effect of

different media, pH, temperature, various carbon and nitrogen sources (amino acids) and various sulphur sources, on their growth, sporulation and chlamydospore formation. A chromatographic study was also undertaken to note the pathway of utilisation of different sugars and amino acids. Effect of hydrogen ion concentration on the utilization of sodium nitrite by four species of Fusarium was also studied.

Total nine media were used in the cultural study, out of which modified Asthana and Hawker's medium 'A' provided good growth and excellent sporulation in all the four species of Fusarium. The medium was simple in constitution and it was possible to modify the various ingredients in it and hence, it was selected as a basal medium for the physiological studies.

Growth and reproduction of fungi are profoundly influenced by the hydrogen ion concentration of the substrate upon which they grow. The study indicated maximum dry weight and excellent sporulation of all the four species of Fusarium at pH 5.5. One thing specially noticed is that at this pH no chlamydospore formation was observed in any of the case. The wide tolerating capacity of the organism i.e. pH 2.5,3,to 10, shows that, they can survive under changing pH of the host tissue during

pathogenesis. The final pH increased and shifted towards neutrality while the initial pH was low. On the other hand in those cases where the initial pH was high, the final pH decreased. The rise in PH of the culture medium has been attributed to the metabolic activities during growth resulting in adsorption of anions or production of ammonia from nitrogenous compounds. Lowering of pH in case of media with higher initial pH was possible due to adsorption of carbondioxide by the fungus in the process of respiration.

Temperature is an important environmental factor affecting the metabolic activities of the fungi. It is evident from the study that growth, sporulation and chlamydospore formation of the present organisms were remarkably influenced by temperature variations. All the four species of Fusarium could grow in a range between 10°C and 40°C, beyond these temperatures their growth were ceased. Good growth and excellent sporulation were recorded at 25°C, but chlamydospore formation was not observed at this temperature.

Carbohydrates being the chief metabolic product have special importance in the nutrition of the microorganisms. The availability of carbon sources in nature may be both, in simple as well as in complex state. Fungi

assimilate the simple sugars of low molecular weight directly while utilization of complex carbon compounds is dependent on a number of factors such as permeability of cell wall, availability of enzymes, pH of the medium etc. In such cases the relative degree of efficiency depends upon the ability with which a particular species is able to convert the complex substances to products of low molecular weight.

Moreover, fungi are so specific in utilization of these substances that a carbon source may be utilized by a fungus while another source of similar chemical structure may prove useless for it. Similarly, not only different genera but different species of same genus also differ in their utilization of carbon compounds. The present four species of Fusarium showed similar response towards a number of mono-, di- and poly-saccharides. Such differences could also be observed in sporulation also.

It has been put forward that although different species may yield similar growth on a number of carbon compounds, yet they differ in one or the other aspect of utilization particularly the pattern of growth, drift in pH of the medium and rate of utilization of sugar. Similar results were also obtained in the present study. All the four species of Fusarium showed good growth on

Ribose, Mannose, Glucose and Sucrose, but they exhibited significant difference in the growth pattern and in the rate of utilization of these sugars.

Absence of hydrolytic products in the culture media during the utilization of oligosaccharides has been reported by earlier workers is an indicative of its direct utilization. (Smith,1949; Mandels,1954; and Tandon and Bilgrami,1957). But it has been shown that fungi are incapable of utilizing high molecular compounds as such. In fact, the absence of hydrolytic products in the culture medium is due to the slow rate of their formation accompanied with its simultaneous utilization. In the present study also hydrolytic products were not detected during utilization of disaccharides. So, it may be presumed that the formation of hydrolytic products were accompanied with its immediate utilization.

Nitrogen is as essential as carbon, needed for growth of fungi. Response of different organisms under study towards various nitrogen sources varied considerably. Amino acids are generally reported to be a good source of nitrogen by many workers. The present species of Fusarium showed some what similar response towards a particular amino acid tested, as all of them yielded nearly same amount of dry weight on it. However, response of

individual species of Fusarium towards different amino acids varied. It is interesting to note that cystine, a sulphur containing amino acid supported excellent growth in all the four species. Singh (1977) reported similar results. Cystine has however, been reported to be a poor source for a number of fungi by many workers.(Grewal,1955; Bilgrami,1962; Prasad,1963).

Chromatographic analysis of the medium containing different amino acids has however, manifested some different results. A particular amino acids on which different species of Fusarium showed similar growth, was utilized at different rate. Not only this, the growth pattern of the present species accomplished at various incubation period also varied on a particular amino acids.

Studies on sulphur sources revealed that, although variations existed among different organisms for the comparative choice of sulphur compounds, yet marked similarities were also obvious.

A number of reports have appeared in the literature regarding the toxic effect of nitrite nitrogen on fungi (Cochrane and Corn,1950; Gordon,1950; Tandon and Bilgrami,1957; Singh,1977; and Arya 1990). The toxicity has been found to be closely related to hydrogen ion

concentration of the medium. In the present study also, the sodium nitrite was toxic (at low pH) to the growth of all Fusarium species. Thus it may be possible to control Fusarium population in acidic soil by addition of sodium nitrite.

The response to the growth of four varieties of pigeon pea was almost similar. A steady increase was observed in all the pigeon pea varieties in shoot and root elongation as well as fresh weight. DPPA - 85.5 variety attained maximum shoot length at the end of 120 days after sowing, rest of the varieties attained more or less similar height.

Rhizosphere studies revealed marked diffrence in the microbial population among rhizosphere and non rhizosphere region of the four varieties of pigeon pea. Presence of Rhizopus nigricans was observed in both rhizopheric and non rhizospheric soils of four varieties of pigeon pea. Rhizospheres have much influence over the microorganisms in soil. But it depends on the type of plant and even variety of plants growing in that soil. Generally rhizosphere soil support good microbial population than non rhizosphere soil. On the contrary in the present study non rhizosphere soil harboured more microorganisms rather than rhizospher soil.

Soil heating (solarization) has been practiced to control soil borne plant pathogens. Transmission of long wave radiations is highly reduced due to soil mulching with polyethylene sheet and this bring about an increase in soil temperature. The findings of the earlier workers like Katan (1981), Stapleton and DeVay (1983), Abel-Rahim et al.(1988) and Mansoor and Saxena (1992), supported the above results. Out of the three different thickness of polyethylene sheets tried, 0.03 m.m. (300 guage) was found efficient in soil heating, but it is not durable for long term use. So, next thickness i.e. 0.06 m.m. is recommended. Maximum heat elevation was, observed at 5 cm depth of the soil. Coloured polyethelene sheets were also tried to understand their feasibility for solarization. Blue coloured one gave promising result. Red coloured was not persistent throughout the experiments, hence it is not at all recommendable.

A marked shift of microbial population was recorded at 45 days of solarization.

Studies on pathogenicity of four species of Fusarium indicated that F. udum and F. oxysporum were most pathogenic, because they induced high percentage of wilting in the 'Arhar' seedlings. In vitro studies revealed that, all the four species were efficient to

produce extracellular toxin, of which F. udum produced more. The severity of infection caused by F. udum may be correlated with its capacity to produce a high amount of Fusaric acid.

Spores of the present organisms were not able to withstand temperatures above 57°C. The thermal death point of the four present organisms differed among themselves.

Morphological studies were carried out under light as well as electron microscope in order to understand the shape, size and orientation of different conidia (micro- and macroconidia) and chamydospores.